In [23]:

```python
import pandas as pd
df = pd.read_csv('tuberculosis.csv')
```

In [25]:

```python
# Cleaning column names
df.columns = (
    df.columns
    .str.replace(r'\(.*?\)', '', regex=True)
    .str.replace('Scaling Factor:1', '', regex=False)
    .str.replace(' ', '_')
    .str.replace(',', '')
    .str.strip()
)
```

In [29]:

```python
# Converting year column to numeric
df['Year'] = df['Year'].str.extract(r'(\d{4})').astype(int)
```

In [35]:

```python
# Renaming long columns to shorter and meaningful ones
df = df.rename(columns={
    'Country': 'Country',
    'State': 'State',
    'Year': 'Year',
    'Sector': 'Sector',
    'TB_KnownStatus': 'TB_KnownStatus',  # Already renamed
    'Percentage_Of_Tuberculosis__Patients_With_Known_Tobacco_Usage_Status_)_':
    'Number_Of_Tobacco_Users_Identified_Amongst_Screened__': 'TB_TobaccoIdenti
    'Percentage_Of_Tobacco_Users_Identified_Amongst_Screened_)_': 'TobaccoIder
    'TB_Linked': 'TB_CessationLinked',  # Already renamed previously
    'Percentage_Of_Tobacco_Users_Linked_With_Tobacco_Cessation_Centres_)_': 'C
    'Number_Of_Tuberculosis__Diabetes_Mellitus__Patients_Linked_To_Diabetic_Tr
    'TB_DM': 'TB_DM',
    'TB_Notified': 'TB_Notified',
    'TB_GlucoseStatus': 'TB_GlucoseStatus'
})
```

In [37]:

```python
# Previewing new column names
print(df.columns.tolist())
```

```
['Country', 'State', 'Year', 'Sector', 'TB_KnownStatus', 'TB_KnownStatus_Perc',
'TB_TobaccoIdentified', 'TobaccoIdentified_Perc', 'TB_CessationLinked', 'Cessat
ionLinked_Perc', 'TB_DM_Treated', 'TB_DM', 'TB_Notified', 'TB_GlucoseStatus']
```

In [39]:

```python
df.head()
```

Out[39]:

	Country	State	Year	Sector	TB_KnownStatus	TB_KnownStatus_Perc	TB_
0	India	Andaman And Nicobar Islands	2024	Public	459.0	80.7	
1	India	Andaman And Nicobar Islands	2024	Private	4.0	30.8	
2	India	Andhra Pradesh	2024	Public	60433.0	95.3	
3	India	Andhra Pradesh	2024	Private	25556.0	96.5	
4	India	Arunachal Pradesh	2024	Public	1900.0	67.7	

In [41]:

```python
# Grouping by State
df_statewise = df.groupby('State').sum(numeric_only=True).reset_index()
```

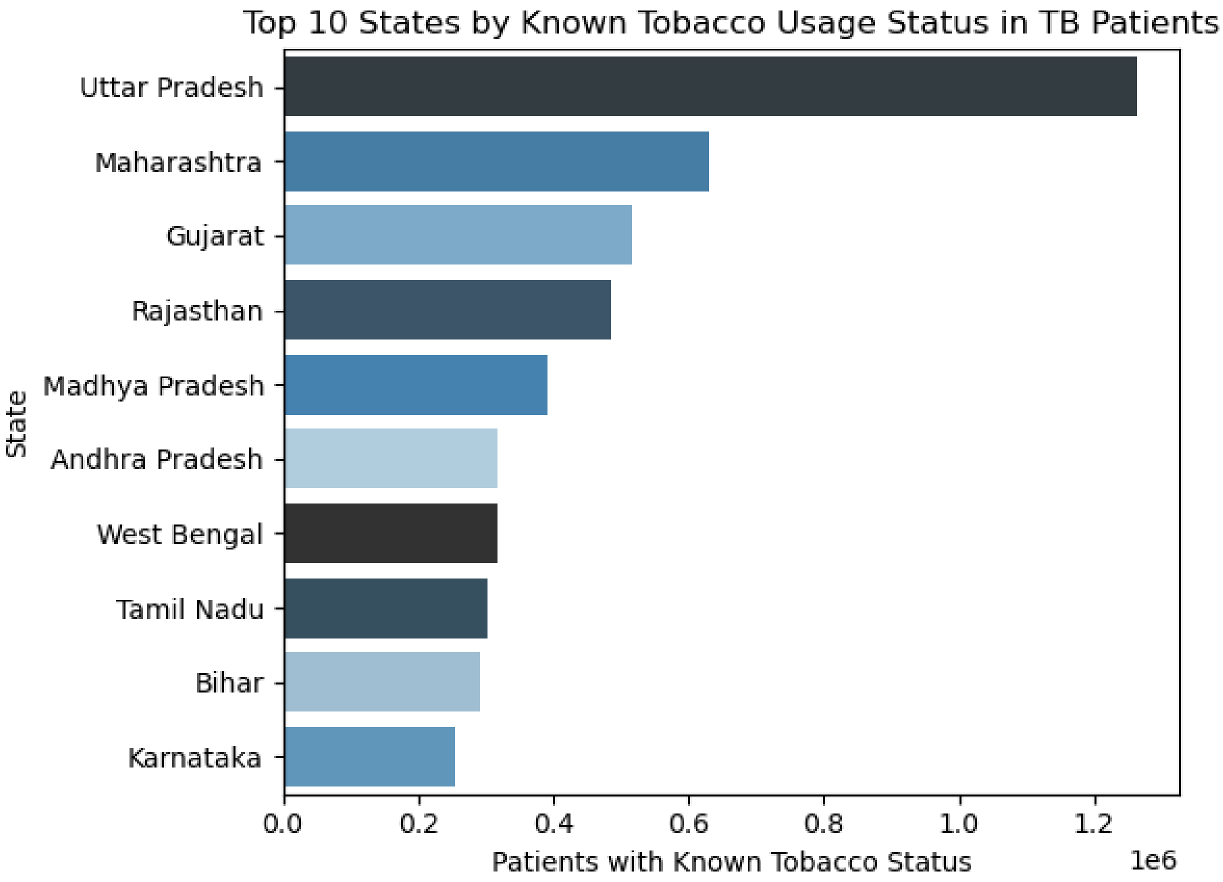
In [43]:

```python
# Calculate metrics
df_statewise['Linkage_Rate'] = (
    df_statewise['TB_CessationLinked'] /
    df_statewise['TB_TobaccoIdentified']
).fillna(0)

df_statewise['Identification_Rate'] = (
    df_statewise['TB_TobaccoIdentified'] /
    df_statewise['TB_KnownStatus']
).fillna(0)
```

Top 10 States by known Tobacco Status

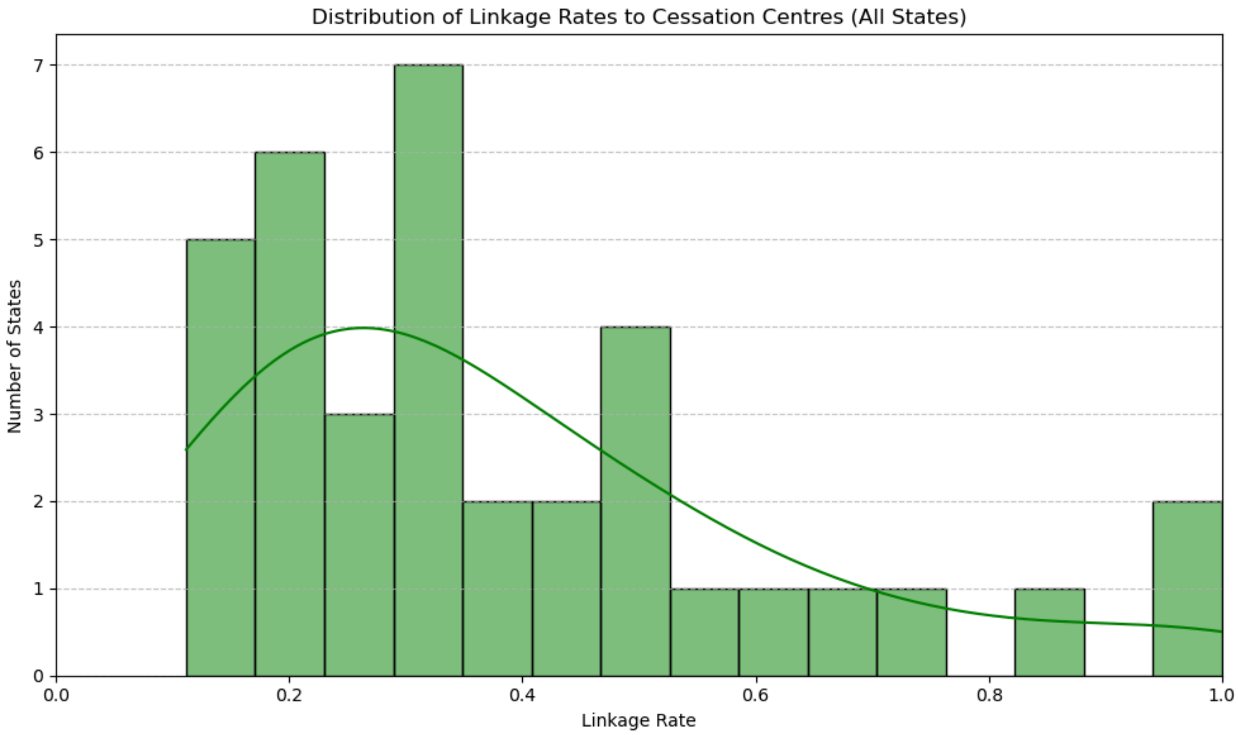
In [61]:

```python
import seaborn as sns
import matplotlib.pyplot as plt
top_known = df_statewise.sort_values('TB_KnownStatus', ascending=False).head(1

sns.barplot(data=top_known, x='TB_KnownStatus', y='State', hue=top_known.index
plt.title('Top 10 States by Known Tobacco Usage Status in TB Patients')
plt.xlabel('Patients with Known Tobacco Status')
plt.ylabel('State')
plt.tight_layout()
plt.show()
```



Histogram of Linkage Rate to Cessation Centres

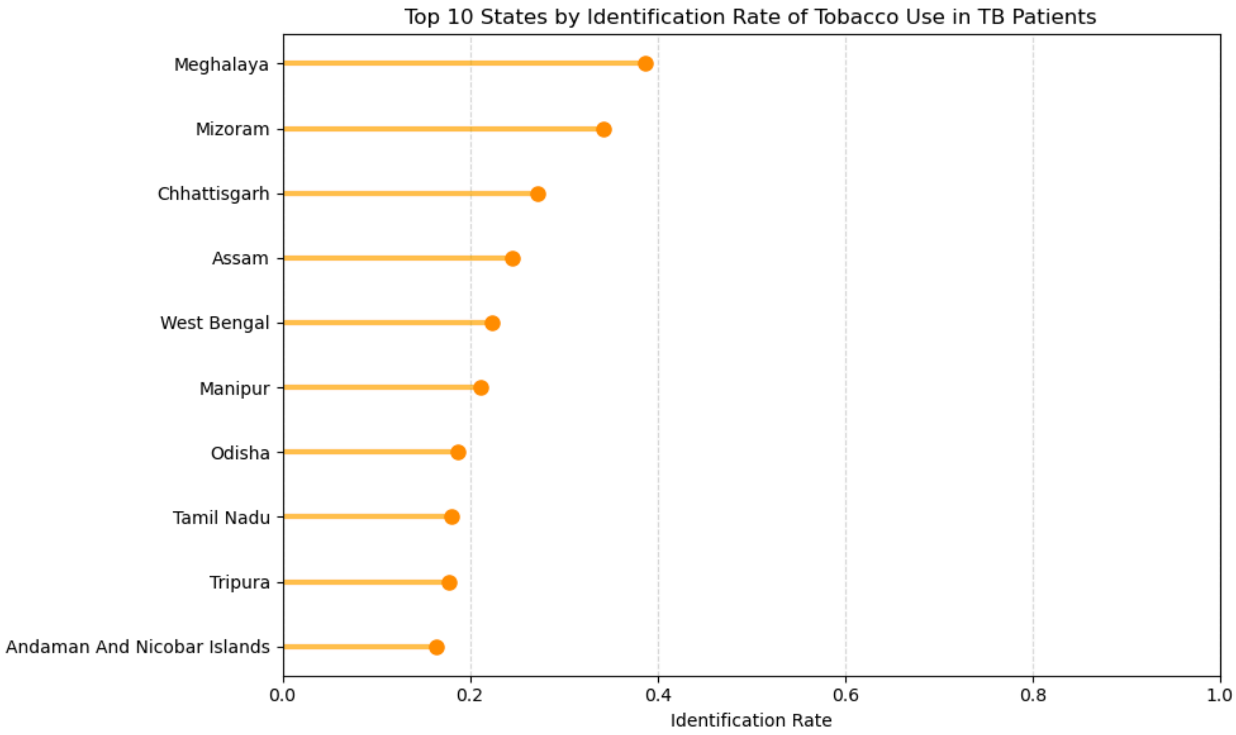
In [70]:
```
plt.figure(figsize=(10, 6))
sns.histplot(df_statewise['Linkage_Rate'], bins=15, kde=True, color='green', e

plt.title('Distribution of Linkage Rates to Cessation Centres (All States)')
plt.xlabel('Linkage Rate')
plt.ylabel('Number of States')
plt.xlim(0, 1)
plt.grid(axis='y', linestyle='--', alpha=0.7)
plt.tight_layout()
plt.show()
```



Lollipop chart- Top 10 States by Identification Rate of Tobacco Users

In [85]:

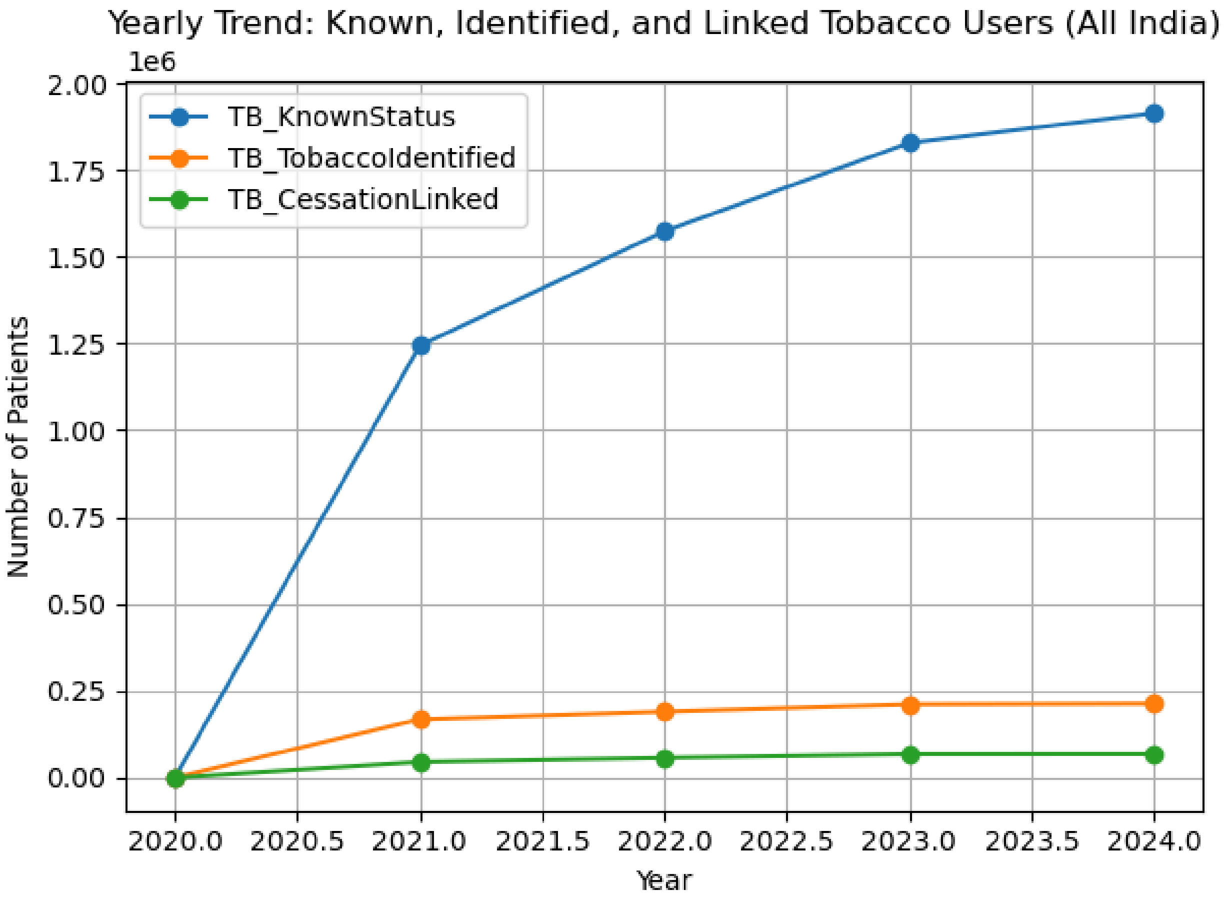
```
# Sort top 10 again for plotting
top_identified = df_statewise.sort_values('Identification_Rate', ascending=Tru

plt.figure(figsize=(10, 6))
plt.hlines(y=top_identified['State'], xmin=0, xmax=top_identified['Identificat
plt.plot(top_identified['Identification_Rate'], top_identified['State'], "o",
plt.title('Top 10 States by Identification Rate of Tobacco Use in TB Patients'
plt.xlabel('Identification Rate')
plt.xlim(0, 1)
plt.grid(axis='x', linestyle='--', alpha=0.5)
plt.tight_layout()
plt.show()
```



Trend Over Years (Line Plot)

Insight: How are known tobacco cases, identification, or linkage changing over time?

```
In [91]: df_yearly = df.groupby('Year')[['TB_KnownStatus', 'TB_TobaccoIdentified', 'TB_

         df_yearly.plot(x='Year', kind='line', marker='o')
         plt.title('Yearly Trend: Known, Identified, and Linked Tobacco Users (All Indi
         plt.ylabel('Number of Patients')
         plt.grid(True)
         plt.tight_layout()
         plt.show()
```

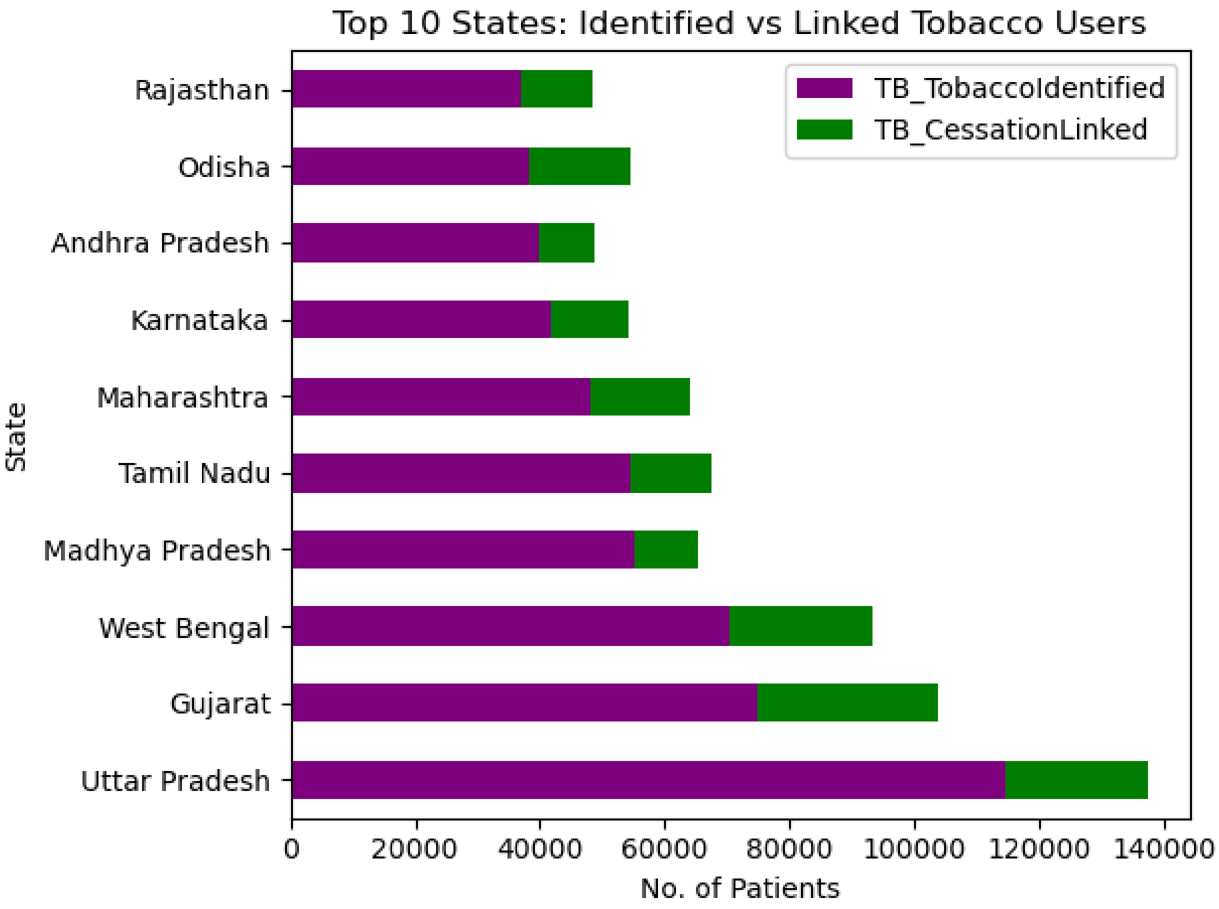


Stacked Bar Chart – Tobacco Identification & Linkage per State

Insight: Compare tobacco user identification vs linkage side-by-side per state

In [96]:

```
subset = df_statewise[['State', 'TB_TobaccoIdentified', 'TB_CessationLinked']]
subset.set_index('State')[['TB_TobaccoIdentified', 'TB_CessationLinked']].plot

plt.title('Top 10 States: Identified vs Linked Tobacco Users')
plt.xlabel('No. of Patients')
plt.tight_layout()
plt.show()
```

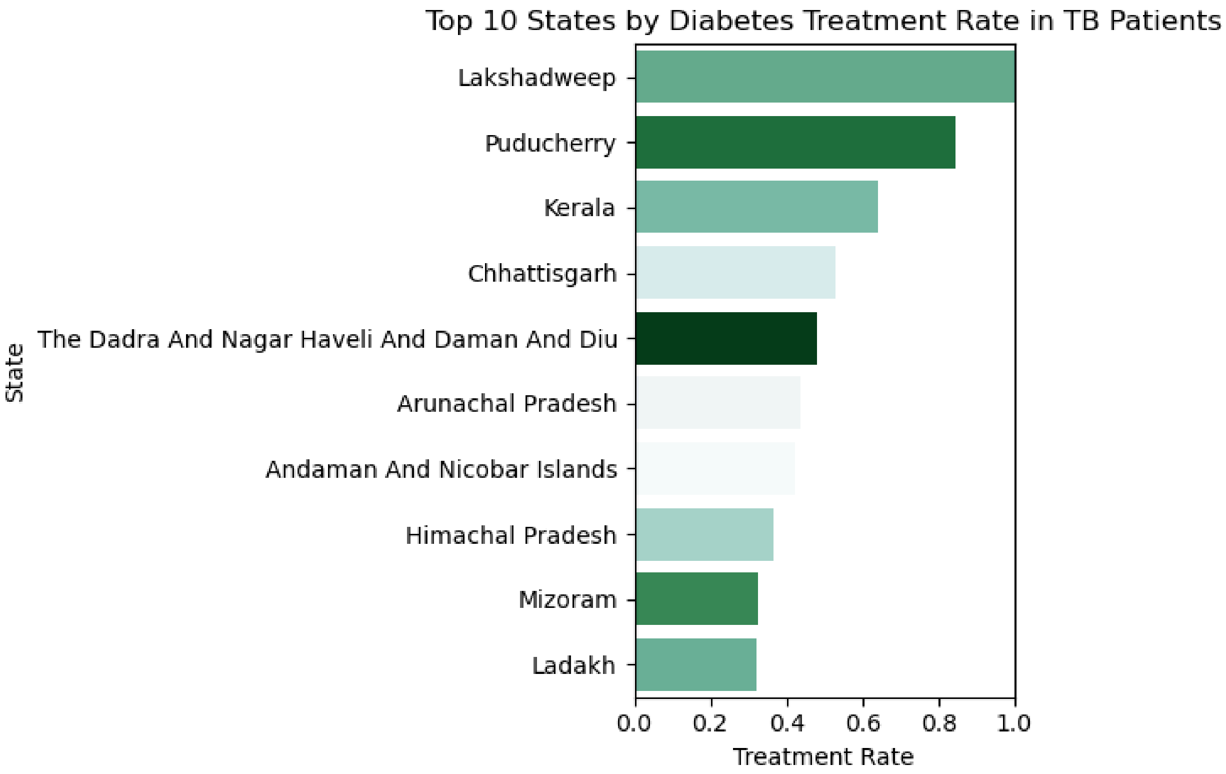


TB + Diabetes Comorbidity Comparison

Insight: States with high TB + Diabetes comorbidity. Is follow-up treatment being provided?

In [101…

```
df_statewise['DM_Treatment_Rate'] = (
    df_statewise['TB_DM_Treated'] / df_statewise['TB_DM']
).fillna(0)

top_dm = df_statewise.sort_values('DM_Treatment_Rate', ascending=False).head(1

sns.barplot(data=top_dm, x='DM_Treatment_Rate',hue=top_dm.index, legend = Fals
plt.title('Top 10 States by Diabetes Treatment Rate in TB Patients')
plt.xlabel('Treatment Rate')
plt.xlim(0, 1)
plt.tight_layout()
plt.show()
```

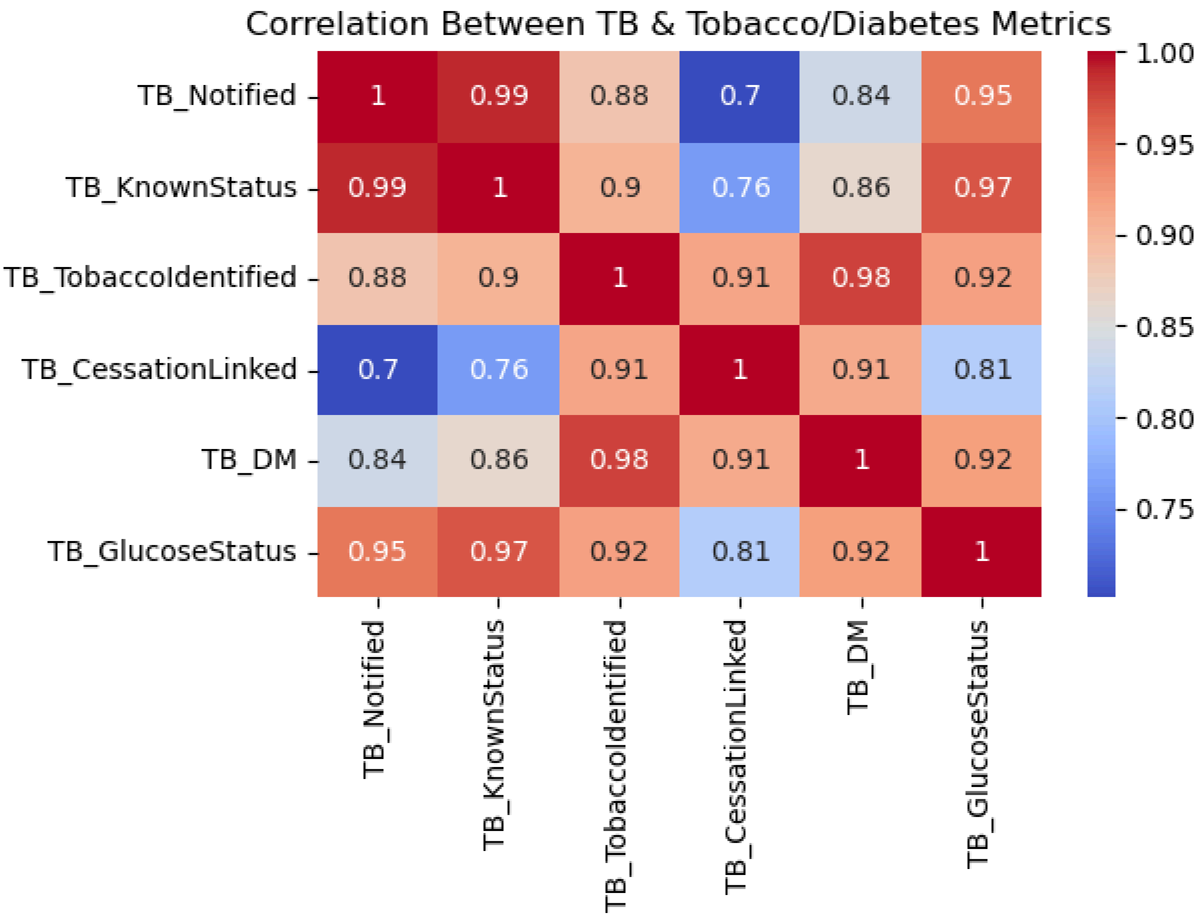


Correlation Heatmap

Insight: Is there a correlation between TB notifications, glucose status, tobacco identification, etc.?

In [104…

```
corr_cols = ['TB_Notified', 'TB_KnownStatus', 'TB_TobaccoIdentified', 'TB_Cess
sns.heatmap(df_statewise[corr_cols].corr(), annot=True, cmap='coolwarm')
plt.title('Correlation Between TB & Tobacco/Diabetes Metrics')
plt.tight_layout()
plt.show()
```

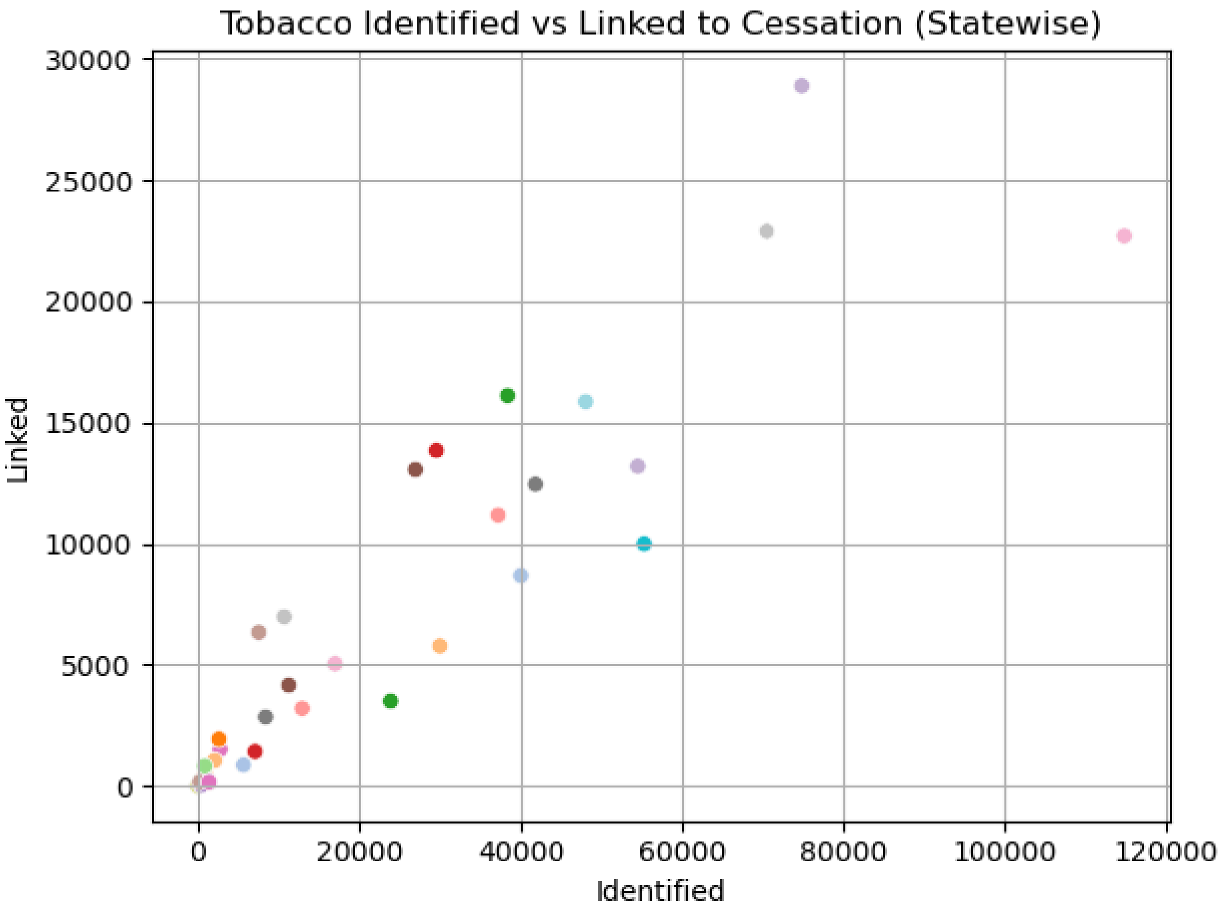


Scatter Plot – Tobacco Identified vs Linked

Insight: Do states that identify more tobacco users also link more to cessation?

In [109…

```
sns.scatterplot(data=df_statewise, x='TB_TobaccoIdentified', y='TB_CessationLi
plt.title('Tobacco Identified vs Linked to Cessation (Statewise)')
plt.xlabel('Identified')
plt.ylabel('Linked')
plt.grid(True)
plt.tight_layout()
plt.show()
```



In [ ]:

```
df.to_csv("cleaned_tuberculosis_data.csv", index=False)
df_statewise.to_csv("statewise_tb_summary.csv", index=False)
```